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TSUNAMI NEWSLETTER - JULY 1995

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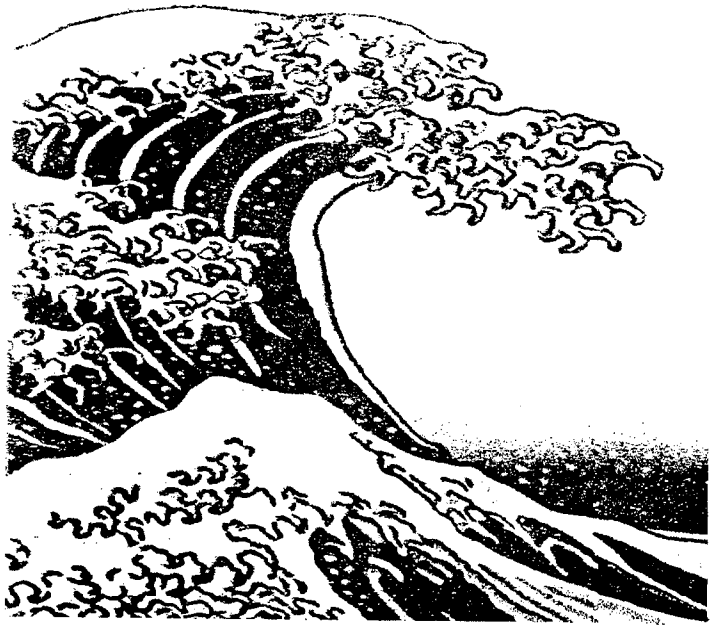
The TSUNAMI NEWSLETTER is published semi-annually in January and July by the International Tsunami Information Center (ITIC) to bring news and information to scientists, engineers, educators, community protection agencies, and governments throughout the world.

We welcome contributions from our readers.

The ITIC is maintained largely by the U.S. National Oceanic & Atmospheric Administration (NOAA) for the Intergovernmental Oceanographic Commission (IOC). The Center's mission is to mitigate the effects of tsunamis throughout the Pacific.



MEMBER STATES

Present membership of the IOC International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) comprises the following 26 Member States:

AUSTRALIA
CANADA
CHILE
CHINA
COLOMBIA
COOK ISLANDS
COSTA RICA
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA
ECUADOR
FIJI
FRANCE
GUATEMALA
INDONESIA
JAPAN
MEXICO
NEW ZEALAND
NICARAGUA
PERU
PHILIPPINES
REPUBLIC OF KOREA
RUSSIAN FEDERATION
SINGAPORE
THAILAND
UNITED KINGDOM (HONG KONG)
UNITED STATES OF AMERICA
WESTERN SAMOA

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NEWS EVENTS

Earthquake and Tsunami Report, January through June 1995

The first half of 1995 has brought terrible destruction and loss of life from earthquakes occurring in Japan and the Russian Federation. At least three small *local* tsunamis were recorded in the Pacific Basin during this reporting period.

Beginning with the October 4, 1994, earthquake and tsunami in the South Kuril Islands - Hokkaido region (see January 1995 *Tsunami Newsletter),* Japan has been hit by (what seems to be) an unprecedented number of earthquakes, many causing nearby damage and some generating tsunamis recorded in the local area. The most damaging earthquake to occur during the period struck the Kobe - Osaka region during the early morning hours of January 17, 1995. Unlike the other earthquakes, this event was centered in a highly populated area and produced damage of staggering proportions. Over 5,000 people were killed and thousands injured while property losses in excess ofUS$l00 billion are possible.

Although located near the coastline, the Kobe earthquake did not generate a tsunami of any significance. This may be the most damaging earthquake (in terms of cost and subsequent rehabilitation) to occur worldwide in the recent past. Earlier in January 1995, earthquakes hit the northern and central areas of Honshu but were located offshore in the Pacific Ocean. The Russian Federation island of Sakhalin was rocked by a devastating earthquake of surface wave magnitude 7.6 during the early morning hours of May 27, 1995, that caused over 1,500 casualties and completely destroyed many apartment buildings in the city of Neftegorsk. Evidence is being collected indicating a small tsunami may have been associated with this earthquake along the Okhotsk Sea coast near the settlements of Sabo and Val.

With localized damage to homes and public buildings, the Ms 6.5 earthquake that hit central and southwestern Colombia on February 8 caused a number of casualties in this industrialized coffee-growing region. Located inland from the coast, the Colombia quake did not generate a tsunami. No tsunami wave activity was associated with the Mw 7.1 earthquake that occurred in the Pacific Ocean off East Cape, North Island, New Zealand on February 5.

Small, local tsunamis (recorded by water level gauges) were generated by earthquakes occurring near Samoa/fonga Islands (April 7), the Philippines (April 21), and near the Loyalty Islands (May 16). What was initially reported as tsunami activity but was probably coseismic subsidence of the nearby land-mass occurred near Wakayama, Japan (January 17 - Kobe earthquake). The Timor, Indonesia (May 14) earthquake may have generated a tsunami due to a coastal or underwater landslide. Detailed reports on these tsunami and the destructive Kobe and Sakhalin earthquakes are covered in this issue of the Tsunami Newsletter.

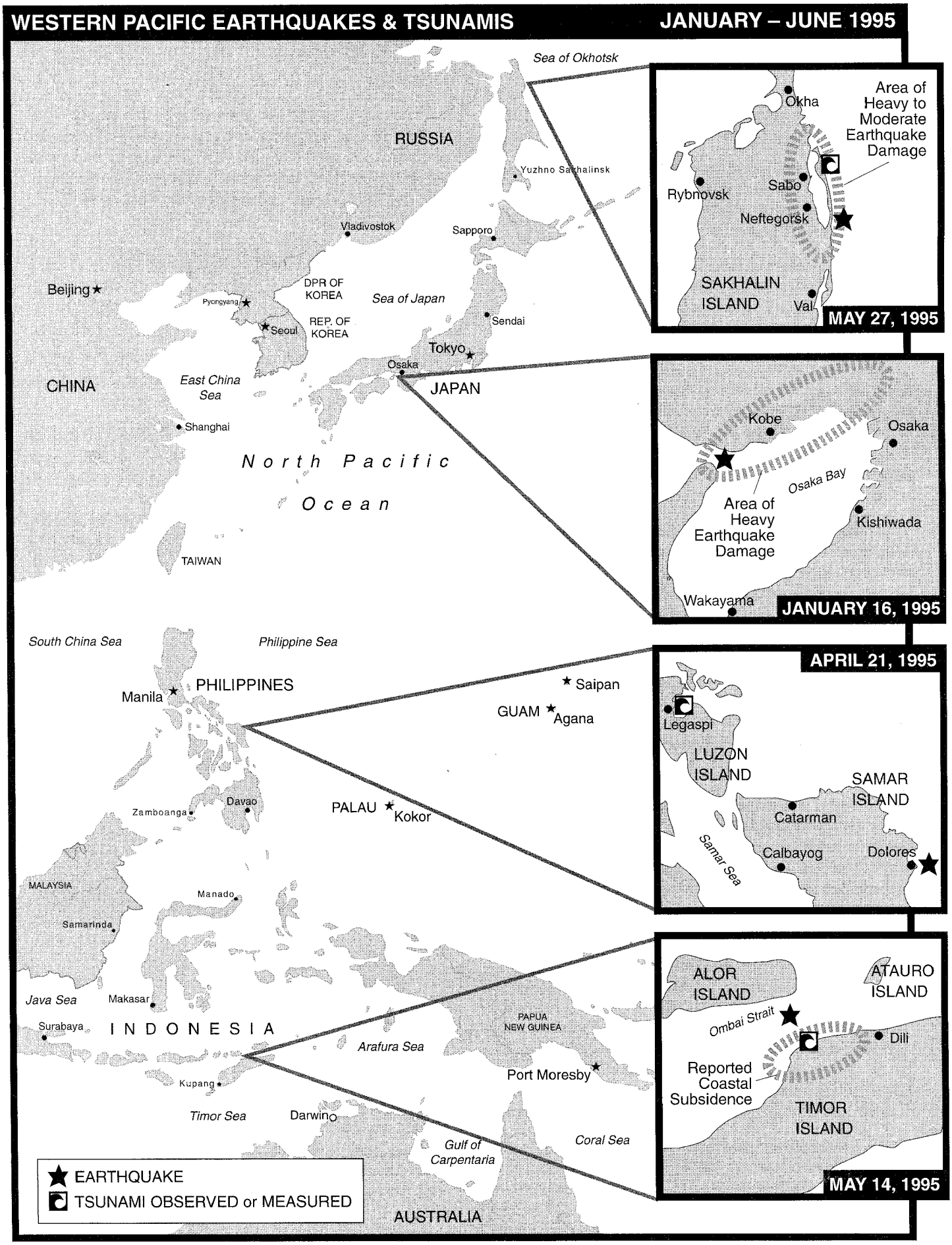
Tsunami Reports

The Great Hanshin Earthquake (Japan) of January 17, 1995

from: ***Bureau For Humanitarian Response Office Of U.S. Foreign Disaster Assistance and International Center for Disaster-Mitigation Engineering (INCEDE)***

On Tuesday. January 17, an earthquake registering 7.2 on the Richter scale struck in the vicinity of Kobe, Japan's sixth largest city, at 5:46 a.m. The Government of Japan reported that more than 5,000 people were killed 'and tens of thousands were injured and left homeless. Seismologists recorded more than 1,000 aftershocks, leading to further damage. The epicenter of the quake was Awaji Island, twenty miles south of Kobe. The worst hit areas were the prefectures of Hyogo and Osaka, the industrial heartland of Japan and home to 14 million people, 10% of. the country's total population. The most devastating effect was felt in Kobe, a city of 1.5 million people and the sixth largest port in the world. The earthquake, which lasted only 20 seconds, left a wide path of destruction. Approximately 109,000 buildings were damaged or destroyed. 1 million homes were left without electricity and gas, and 1.2 million people were without running water. Gas leaks were reported in 1,400

An arcade filled with fallen debris. *(INCEDE)*


WESTERN PACIFIC EARTHQUAKES & TSUNAMIS
JANUARY – JUNE 1995
Sea of Okhotsk
RUSSIA
Yuzhno Sakhalinsk
Vladivostok
Sapporo
Beijing
DPR OF KOREA
Pyongyang
Sea of Japan
Seoul
REP. OF KOREA
Sendai
Tokyo
Osaka
CHINA
East China Sea
JAPAN
Shanghai
North Pacific Ocean
TAIWAN
Okha
Area of Heavy to Moderate Earthquake Damage
Rybnovsk
Sabo
Neftegorsk
SAKHALIN ISLAND
Val
MAY 27, 1995
Kobe
Osaka
Osaka Bay
Area of Heavy Earthquake Damage
Kishiwada
Wakayama
JANUARY 16, 1995
South China Sea
Philippine Sea
Manila
PHILIPPINES
Saipan
GUAM
Agana
APRIL 21, 1995
Legaspi
LUZON ISLAND
SAMAR ISLAND
Catarman
Samar Sea
Calbayog
Dolores
PALAU
Kokor
Zamboanga
Davao
MALAYSIA
Manado
Samarinda
Java Sea
Makasar
Surabaya
INDONESIA
Arafura Sea
PAPUA NEW GUINEA
Port Moresby
Kupang
Timor Sea
Darwin
Gulf of Carpentaria
Coral Sea
ALOR ISLAND
ATAURO ISLAND
Ombai Strait
Dili
Reported Coastal Subsidence
TIMOR ISLAND
MAY 14, 1995
EARTHQUAKE
TSUNAMI OBSERVED or MEASURED
AUSTRALIA

locations. Damage estimates range between $40 billion to $100 billion. Widespread fires, fueled by broken gas lines, raged throughout the area for more than 10 days, burning over 20,000 homes and scorching 250 acres. Water, gas, telephone, and electrical lines were ruptured leaving tens of thousands cut off from the outside world. Road, rail, shipping, and ferry service was totally disrupted causing a logistical nightmare for relief efforts. (ed. no recorded tsunami was generated by this earthquake, however, a coseismic deformation of the sea floor near Wakayama of about 20 cm was reported)

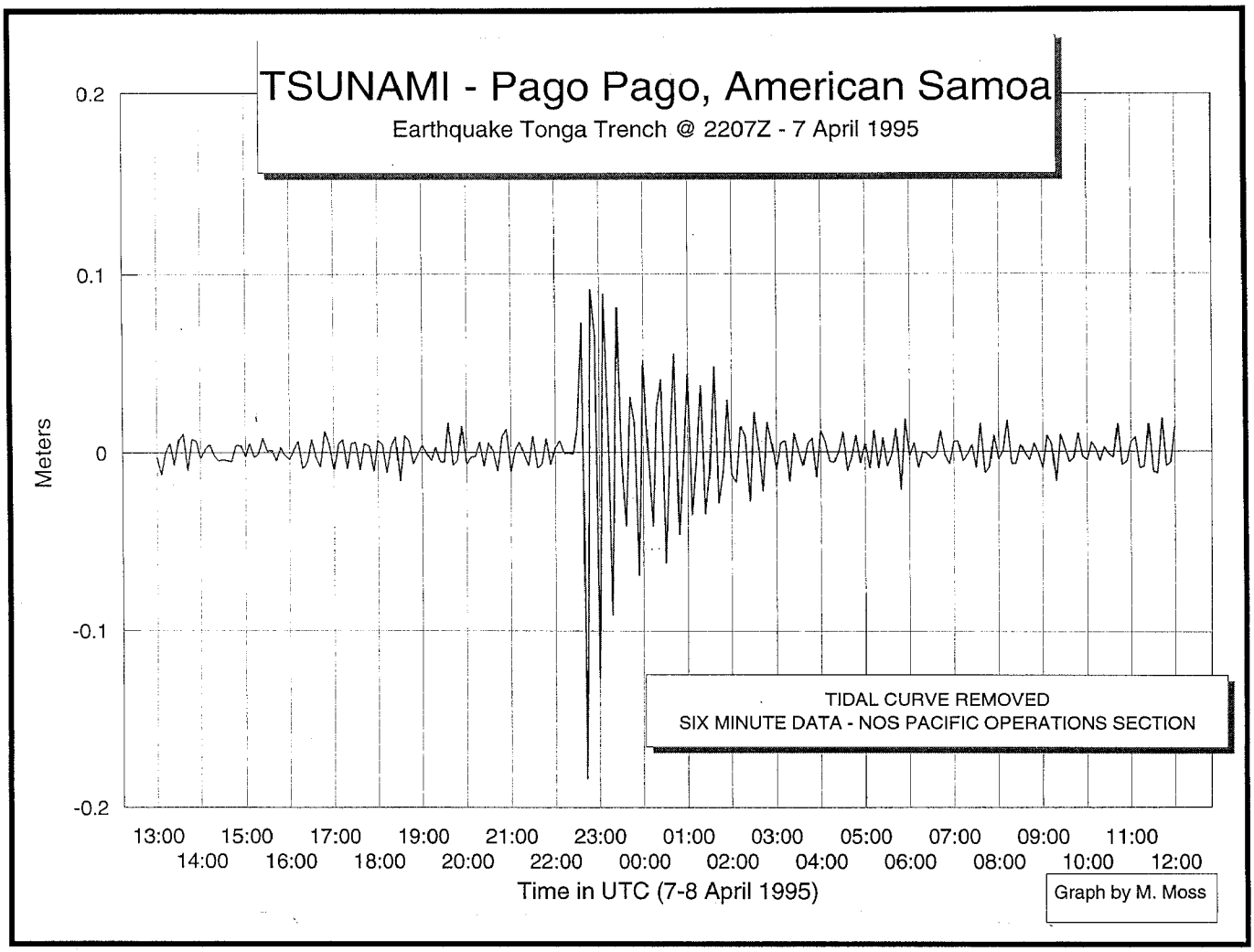
"The Great Hanshin Earthquake will have profound influence on Japan's earthquake preparedness. The earthquake, which proved to be a combination of a number of worst case scenarios, again reminded us that fight(ing) against natural disaster is an endeavor where one cannot afford to relax" *(INCEDE)*.

New Zealand Earthquakes of February 5 - 10, 1995

A series of strong to moderate earthquakes occurred during the period of February 5 through 10, 1995 off the east coast of North Island, New Zealand. The strongest of the earthquakes hit the area on February 5, an Mw 7.1 (NEIC), and was felt widely throughout most of North Island and as far south as Christchurch. ITIC queried the New Zealand Ministry of Civil Defence for reports of any unusual (tsunami) wave activity associated with the earthquake. Mr. ET Finninmore, Ministry of Civil Defence, indicated no abnormal tidal fluctuations were recorded or observed, however, there was some slight damage caused by the earthquake itself.

Tonga-Samoa Earthquake and Tsunami of April 7, 1995

A major earthquake of surface wave magnitude 8.0 (USGS/NEIC) occurred in the vicinity of the (north) Tonga Islands and Western Samoa at 22:07 UTC, on April 7, 1995. LDG-CPPT (Papeete) reported a seismic moment of 1.1×10^{20} Newton-meters; a moment magnitude of about 8. Based on the earthquake's magnitude and location, PTWC issued a regional tsunami WARNING for the area within three hours tsunami



travel time and a tsunami WATCH for the area from 3 to 6 hours tsunami travel time. A large area from Hawaii to New Zealand was covered by the tsunami watch. A report from the National Weather Service office in Pago Pago, American Samoa, indicated local residents felt the strong temblor in their area and vacated offices while others said items fell off shelves.

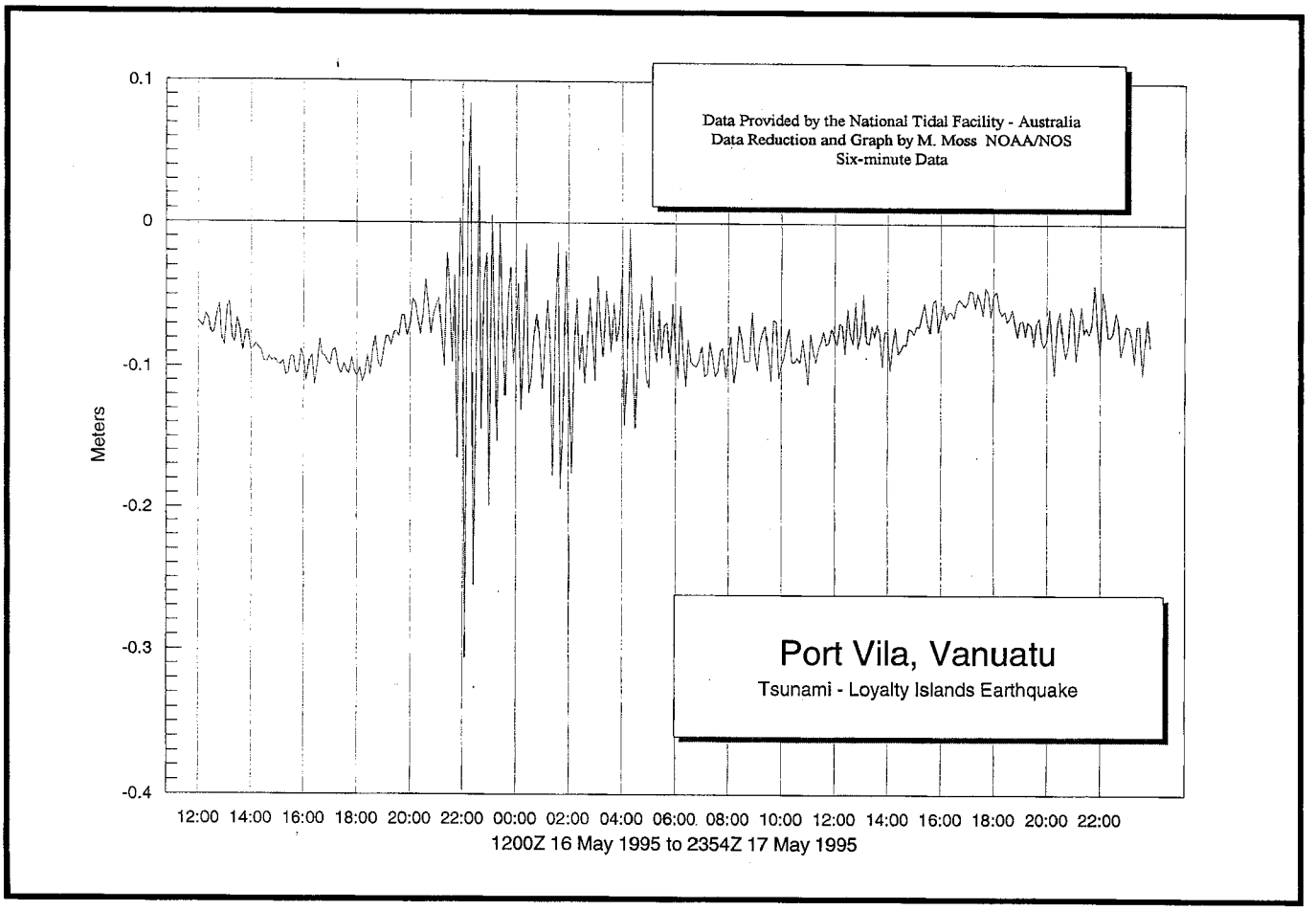
This earthquake generated a small tsunami that was recorded by the Pago Pago, American Samoa and Niue Island tide gauges. The NOAA - National Ocean Service (NOS) tide gauge at Pago Pago, using a 6-minute sampling rate, recorded a tsunami of nearly 30 cm (peak-to-trough, maximum). NOS water level stations at Easter Island and Papeete, Tahiti did not record an unusual wave activity. The Niue satellite telemetered water level gauge clearly shows maximum tsunami wave amplitude of about 5 cm. Based on this information, the regional tsunami warning and extended watch were canceled at 23:22 UTC by PTWC.

Samar Island, Philippines Earthquakes and Tsunami of April 21, 1995

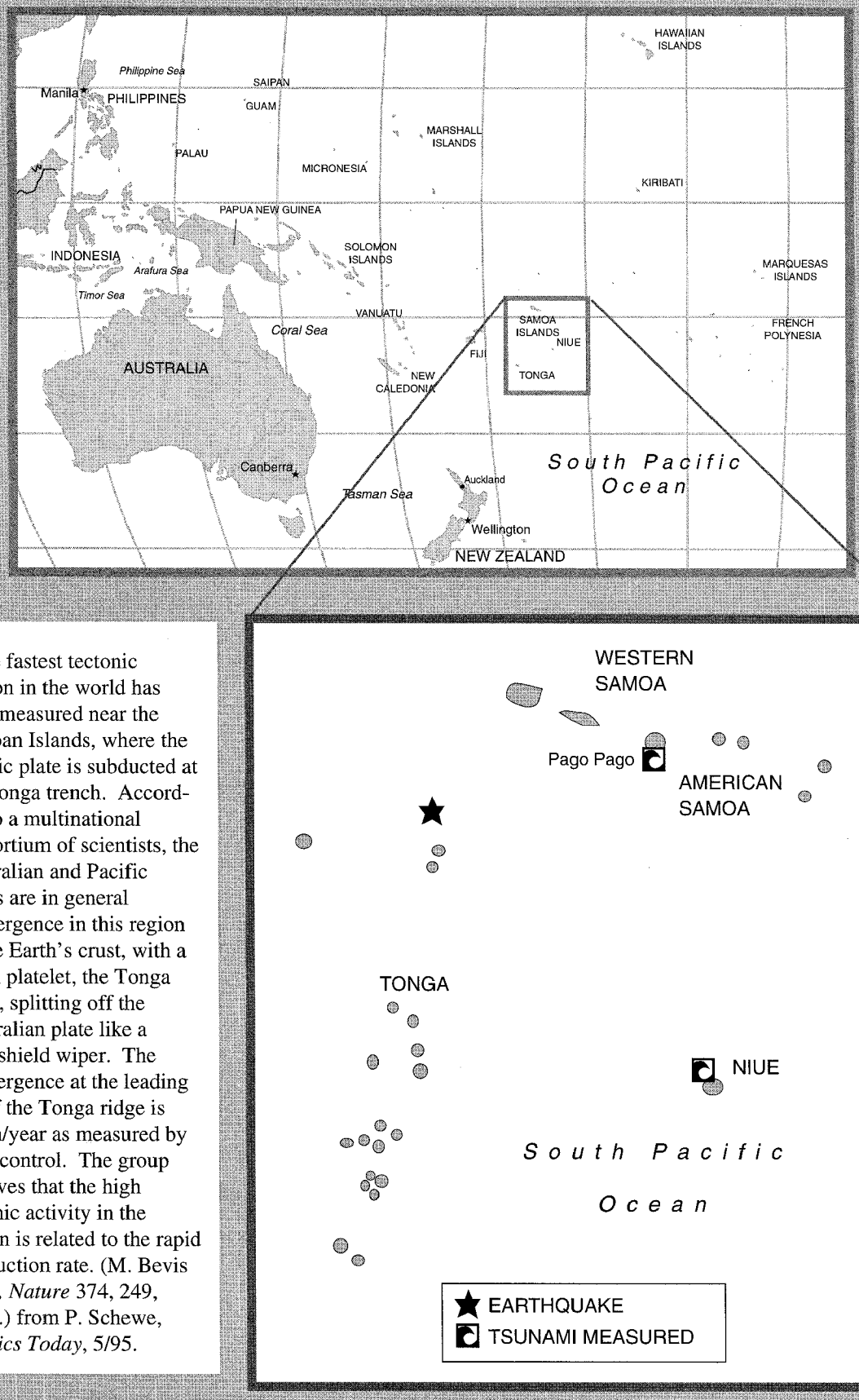
A complex series of strong earthquakes shook the central Philippines, near Samar Island, on the morning of April 21, 1995. The four largest events were near Ms 7, with the earthquake occurring at 00:35 UTC registering Ms 7.3. The earthquakes occurred off the eastern coast of Samar Island near the town of Dolores and were felt over a broad area. It appears this earthquake series generated a small 10 cm tsunami that was recorded by the tide gauge at Legaspi, Philippines. The Legaspi tide gauge had just been recently upgraded with satellite telemetry in a cooperative effort between the Philippine C&GS and PTWC. The telemetry system worked perfectly, transmitting the water level data to PTWC and the Philippines for rapid analysis of the tsunami event. PTWC issued a tsunami information bulletin for the first earthquake that occurred at 00:10 UTC. Two weeks later, on May 5, 1995, a strong earthquake of Ms 7.0 hit the same general region and was felt as far west as southern Luzon island. No tsunami was recorded by this latest event.

Timor Indonesia Earthquake of May 14, 1995

A very unusual earthquake hit the Timor Island region of Indonesia at 11:33 UTC on May 14, 1995 on the north side of the island near the Ombai Strait. The Ms 6.8 earthquake was responsible, apparently, for a small area of coseismic subsidence along the coastline that was confirmed by a field survey



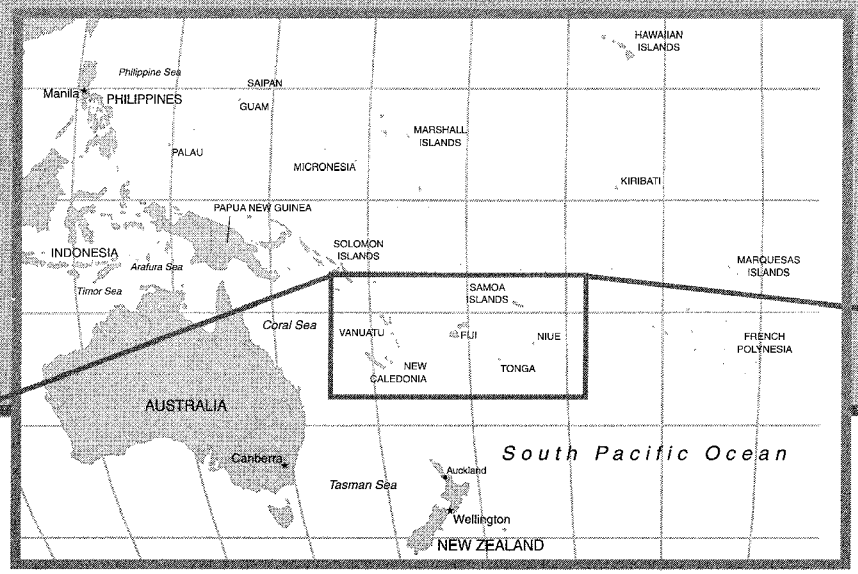
TONGA ISLANDS – SAMOA EARTHQUAKE & TSUNAMI — APRIL 7, 1995



The fastest tectonic motion in the world has been measured near the Samoan Islands, where the Pacific plate is subducted at the Tonga trench. According to a multinational consortium of scientists, the Australian and Pacific plates are in general convergence in this region of the Earth's crust, with a small platelet, the Tonga ridge, splitting off the Australian plate like a windshield wiper. The convergence at the leading tip of the Tonga ridge is 24cm/year as measured by GPS control. The group believes that the high seismic activity in the region is related to the rapid subduction rate. (M. Bevis *et al., Nature* 374, 249, 1995.) from P. Schewe, *Physics Today*, 5/95.

LOYALTY ISLANDS REGION EARTHQUAKE AND TSUNAMI

MAY 16, 1995



EARTHQUAKE

TSUNAMI MEASURED

WESTERN SAMOA

Apia

Pago Pago

AMERICAN SAMOA

FIJI

VANUATU

Port Villa

Lautoka

Suva

COOK ISLANDS

NIUE

Nuku'alofa

Rarotonga

New Caledonia

Loyalty Islands

TONGA

South Pacific Ocean

conducted by Indonesia's Meteorological and Geophysical Agency. One of the initial reports from the earthquake site said a 4 m (tsunami) wave flooded an area (120 m inland) causing the disappearance of 11 people and damaging a number of houses and boats. There has been some discussion and speculation that, possibly, a coastal or underwater landslide may have been associated with the earthquake and was responsible for generating a tsunami. A field report filed by GS Prasetya (Tsunami Research Center, Coastal Engineering Laboratory - Jakarta) indicates the subsided areas consisted of sediment and fine sand and were discontinuous. There were no eye-witnesses that saw the incoming wave that immediately followed the ground shaking of the earthquake.

Loyalty Islands Earthquake and Tsunami of May 16, 1995

A strong earthquake of surface wave magnitude 7.7 occurred in the vicinity of the Loyalty Islands on May 16, 1995. Based on the location and magnitude of this event, PTWC issued a regional tsunami WARNING and WATCH. The regional tsunami warning included, in-part, New Caledonia, Fiji, Nauru, Western Samoa and American Samoa. The tsunami watch was issued for the area covering an additional three hours of tsunami wave travel time. A second tsunami bulletin issued by PTWC extended the tsunami warning and watch by an additional one-hour of wave travel time when no tsunami wave reports could confirm/deny any damaging waves. Once data from the water level stations in the vicinity of the earthquake were received and analyzed by PTWC, the tsunami warning/watch were canceled as no damaging wave activity was reported. (Tide gauge records indicate the tsunami was measured at various locations in New South Wales, Australia; e-mail Col Lynam, University of Queensland.) Tsunami wave heights (*data are preliminary - maximum peak-to-trough*) were recorded at the following water level stations:

Location	Wave Height	Data Source*
Suva, Fiji	about 3-5 cm	(NOS)
Nuku'alofa, Tonga	3 cm	(NTF)
Apia, Western Samoa	3 cm	(NTF)
Rarotonga, Cook Islands	3 cm	(NTF)
Lautoka, Fiji	6 cm	(NTF)
Pago Pago, American Samoa	10 cm	(NOS)
Port Villa, Vanuatu	40 cm	(NTF)

According to data provided by the NTF, tsunami waves are not detected visually on tide records in:
Honiara, Solomon Islands
Funafuti, Tuvalu
Nauru
Betio, Kiribati
Majuro, Marshall Islands

**[data provided by Australia National Tidal Facility (NTF) and US National Ocean Service (NOS)]*

Sakhalin (Neftegorsk), Russia Earthquake and Possible Tsunami of May 27, 1995

The far eastern island of Sakhalin in the Russian Federation was hit by a devastating earthquake of surface wave magnitude 7.6 during the early morning hours of May 27, 1995 when most of the residents of the town of Neftegorsk were sound asleep. Following intensive rescue efforts by local officials and other authorities from the Federation, numerous survivors were found, however, over 1,500 people lost their lives from this earthquake that reduced apartment buildings in Neftegorsk to heaps of rubble. The town of Neftegorsk, before the earthquake, had a population of 2,997.

According to a preliminary report filed in early June by Alexei Ivashchenko and Victor Kaistrenko, two Federation scientific investigation teams comprised of the Seismological Party and Institute of Marine Geology and Geophysics are at the earthquake region collecting macroseismic data and traces of possible small tsunami.

One group reported that a small but not distinct tsunami due to this event occurred on the Okhotsk Sea coast near the settlements of Sabo and Val according to information from fishermen that were on the coast the night of the event. They reported that near Sabo "ice on the Okhotsk sea started to go to the coast after the earthquake", and, near Val, "water waves came to the river mouth after the earthquake." Another reported stated there was small wave action of about 20 cm near the mouth of the Sabo River in the Piltun Gulf. Preliminary information from the nearest tide gauge at Nogliki (about 150 km to the south from Neftegorsk) indicates no tsunami was recorded. All marigrams, however, will be inspected and post-processed to validate this report.

A Japanese seismological team has joined the teams from Russia and have installed a local seismic network that is registering about 500 (small) aftershocks per day.

Update - Skagway, Alaska Landslide and Tsunami of November 3, 1994

also see January 1995 ITIC Tsunami Newsletter

The non-seismic, landslide tsunami event that occurred in Skagway, Alaska, last year was recorded by the Skagway tide gauge as a series of 1 m (maximum) amplitude waves with a period of about 3 minutes decaying over one hour following the landslide event. An eye witness account, based on movement of a barge alongside the railway dock, provides evidence of a maximum (observed) wave height of 9-11 m at the shore line. In a Harbor Inspection Report filed by the State of Alaska, it is noted (presumed) a 28 foot high wave was generated by the failure of the dock.

It further says waters in the harbor basin were drawn out into the channel and that persons living aboard (boats) reported a

sudden jolt that they speculate as the impact of their boats on the bottom of the harbor basin. Moments later seven separate wave surges passed through the harbor breaking boat mooring lines and damaging vessels and floats. The single fatality from this tsunami event occurred on the railroad dock and not the ferry dock as originally reported in the January 1995 ITIC Newsletter. The editor thanks Dr. Catherine Petroff (University of Washington), Philip Watts (California Institute of Technology), Jim Lander and Tom Sokolowski for providing additional information on this tsunami.

IOC/ITSU

List of National Contacts, UPDATE

The following corrections to the list of ICG/ITSU National Contacts published in the December 1993 ITIC Newsletter reflects changes received at ITIC through 30 June 1995. A complete, up-to-date listing of the ICG/ITSU National Contacts (based on the latest information to be presented at ITSU-XV) will be included with the January 1996 issue of the ITIC Tsunami Newsletter. As always, please inform ITIC whenever there are changes.

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Visiting Experts Programme for 1995

from IOC Circular Letter No. 1458, dated 9 May 1995

In order to improve the International Tsunami Warning System in the Pacific, a Visiting Experts Programme, sponsored by the IOC and administered through the ITIC, is available to scientists and experts of the IOC Member States working in the field of *tsunamis*. The program includes training in such fields as, 1) tsunami warning system operations and communications, 2) equipment and instrumentation, 3) research and modeling, and 4) application to the objectives and goals of the IDNDR. The training of two experts is scheduled to take place at ITIC during the period of October 16 through November 13, 1995 in Honolulu, Hawaii.

Nomination of qualified persons and their Curriculum Vitae should be sent to the IOC Secretary, with copies to the Director, ITIC. Preference will be given to nominees from those countries that already participate actively or intend to participate in the Tsunami Warning System in the Pacific. Those countries who submitted their candidates for the 1994 Training Course should reconfirm their names and interest to retain their nomination for the 1995 Training Course. The closing date for submission of nominations is August 15, 1995.

Fifteenth Session of the ICG/ITSU

The Fifteenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific (ITSU-XV) will take place, at the kind invitation of the Government of France, at the Laboratoire de Geophysique in Papeete, Tahiti - French Polynesia, 24-28 July 1995 (per IOC Circular Letter No. 1445, dated 8 February 1995). The actual meeting site is the Maeva Beach Hotel in Punauia, near the Faaa International Airport. Delegates from the ICG/ITSU Member States will present National Reports on activities in the field of tsunami mitigation and preparedness along with a many other topics to be discussed at the meeting.

Some agenda items of interest include the real-time exchange of seismic and tsunami data, the Tsunami Inundation Modeling Exchange Project, standards for tsunami run-up and damage surveys, revision of the Tsunami Warning System Master Plan, electronic bulletin boards and the Internet for tsunami information, tsunami databases, and other tsunami-related matters. Francois Schindele, with the CPPT-Laboratoire de Geophysique, is handling local arrangements for the meeting. A complete report on ITSU-XV will be featured in the January 1996 ITIC Tsunami Newsletter.

INTERNATIONAL DECADE FOR NATURAL DISASTER REDUCTION (IDNDR)

Resolution on IDNDR Approved

By adopting a resolution (A/49/22) the UN General Assembly endorsed on December 2, 1994 the Yokohama Strategy for a Safer World, in particular its Plan of Action, adopted on May 27, 1994 by the World Conference on Natural Disaster Reduction. The Assembly invited the Secretary-General, in order to secure the timely implementation of the Yokohama Strategy and its Plan of Action, to make proposals on all possible ways

and means to ensure the functional security and continuity of disaster prevention, mitigation and preparedness. The resolution also requests the Secretary-General to appeal to all Member States, international financial institutions and the private sector to contribute generously to the Trust Fund for financing activities envisaged by the Yokohama Strategy.

The General Assembly decided to convene, not later than the year 2000, a second world conference on natural disaster reduction in order to carry out an overall review of the accomplishments of the Decade (IDNDR) and map a strategy for continued disaster reduction activities into the 21st Century. *(from: STOP - Disasters, Osservatorio Vesuviano, Naples, Italy)*

New ITIC Director Named!

The last few months have seen some major personnel changes at ITIC. Salvador Farreras arrived as ITIC's new Associate Director in April (see related article) while Dr. Charles (Chip) McCreery has been named as ITIC's new Director. Dennis Sigrist, ITIC's Acting Director since July 1993, is making a career move to the US Mainland by saying farewell to Honolulu and ITIC at the end of August.

ITIC's Acting Director is leaving the position with great respect and admiration for the international tsunami community and the numerous, diverse efforts that are underway to mitigate the impact of tsunamis for the protection of life and property. We will be sure to include more information on ITIC's new Director in the next issue of the Tsunami Newsletter.

Salvador Farreras - ITIC's *New* Associate Director Arrives!

The Acting Director, ITIC, is pleased to report that Salvador Farreras has assumed the post of Associate Director, ITIC, effective April 27, 1995. Salvador's secondment as Associate Director would not have been possible without the generous support of Dr. M. Martinez Garcia, Director General - CICESE/ Ensenada, and the government of Mexico. The financial support of IOC is also noted with great appreciation for providing the funds necessary to help defray the high cost of living in Honolulu.

Salvador's one-year assignment in Honolulu will run through May 1, 1996 when it is hoped another Associate Director will be offered from one of the ICG/ITSU Member States ensuring needed continuity in the position. As our readers might recall, it has been some time since an Associate Director has been posted at ITIC. Mr. Farreras will be joining ITIC during a time of heightened tsunami activity Pacific-wide. He will be involved in a number of ICG/ITSU activities including, but not limited to, the Southwest Pacific Regional Tsunami Warning System, an updated Master Plan for the PTWS, standardized tsunami survey procedures and automation of ITIC library resources. Salvador's new Internet address at ITIC is: farreras@ptwc.noaa.gov.

Change in Publication Dates, ITIC Tsunami Newsletter

The ITIC Tsunami Newsletter, distributed semi-annually, has changed publication dates. Beginning with Volume 27, number 1 (January 1995), the ITIC Newsletter will be published in January and July. For *1994* only one issue was published, namely Volume 26, number 1 in July. The publication date change from December to January will permit seismic/tsunami event coverage for the complete (previous) calendar year.

Visitors to ITIC

The first six months at ITIC have seen a number of visitors pass through our office in Honolulu. ITIC hosted the **ITSU Officers Meeting** in late January bringing together the key individuals responsible for monitoring and reviewing intersessional ITSU activities and making preparations for ITSU-XV. Those in attendance included Youri Oliounine, IOC Senior Assistant Secretary, Hugo Gorziglia, Chairman-ITSU; Hiroo Uchiike, Vice-Chairman ITSU; Dick Hagemeyer, Past-Chairman ITSU, Dennis Sigrist, Director-ITIC; Salvador Farreras, Associate Director-ITIC; Mike Blackford, GIC-PTWC; and Francois Schindele, LDG-Papeete.

Mr. John Dear with the **Australia Bureau of Meteorology** visited ITIC and PTWC on March 27 in conjunction with the World Area Forecasting System (aviation) meeting in Honolulu. Mr. Dear is responsible for tsunami-related matters within the Bureau of Meteorology. He had a very productive visit at ITIC and reviewed tsunami warning system operations and communications at PTWC. Allan Suskin and Marc Gourd with the **Australia National Tidal Facility** (NTF) at Adelaide (The Flinders University), visited ITIC and PTWC on April 25 in conjunction with further travel to the US mainland. We discussed tsunami-related matters at ITIC and PTWC and application to developing a national tsunami warning program in Australia. The NTF has established and operates state-of-the art sea-water level gauges around Australia as well as a number (soon to be 11) of important locations in the South Pacific. These gauges support the data needs of various national and international projects with the very real application of monitoring and reporting on unusual tsunami wave activity (see tsunami report of May 16, 1995).

Other visitors during the period included officials from Hawaii State and county civil defense offices, research staff from the University of Hawaii, and the general public.

ITIC on the Move

It is expected ITIC will move to a new office along with the Pacific Region Headquarters of the National Weather Service by August 1995. ITIC will relocate to a another office building in downtown Honolulu, near our present location. In the mean time, continue using our present mailing address, phone, fax and e-mail numbers. Our new phone numbers, effective on

or about September 1, 1995, are listed on the front inside cover of this issue of the Tsunami Newsletter.

NATIONAL AND AREA REPORTS

Legaspi, Philippines Tide Gauge Upgraded With Satellite Telemetry

In a cooperative effort among the Philippine Coast and Geodetic Survey, the Japan Meteorological Agency, PTWC and ITIC, the tide gauge at Legaspi (Philippines) has been upgraded with a near real-time satellite telemetry capability. The Philippines, Japan and the United States provided the necessary resources to accomplish this task. Technicians from the US (National Weather Service - PTWC) cooperated with personnel from the Philippine Coast and Geodetic Survey to complete the upgrade in April 1995.

Prior arrangements with Japan to utilize their GMS satellite for communications relay helped in implementing the telemetry upgrade in a timely manner. Water level data are now available to all users as standard messages sent on the Global Telecommunications Systems. This telemetry upgrade is similar to those installed at Yap (Federated States of Micronesia) and Malakal (Republic of Palau) in 1991. Soon after the telemetry enhancement was installed, the tsunami generated by the earthquake of April 21, 1995, near Samar Island (Philippines) was recorded, digitized and telemetered by the instrumentation. Melanie Deocampo, Philippine C&GS, as well as Rich Nygard and Derek Lee Loy (National Weather Service) provided the necessary coordination and on-site field support to bring this cooperative project to fruition. ITIC provided the necessary international coordination amongst the various parties involved.

Deep Ocean Pressure Gauge Telemetry Project - Prototype Tsunami Real-Time Reporting System

NOAA's Pacific Marine Environmental Laboratory (PMEL) in Seattle, Washington USA, reports initial success on an acoustic telemetry project that acoustically transmits data from an ocean bottom pressure sensor to a moored surface buoy. The mooring is located about 225 nm off the Washington coast in 2650 meters of water and was deployed on May 23, 1995. The buoy is connected by wire rope and nylon line to an acoustic release and anchor on the sea floor. A package on the buoy holds an acoustic modem and microprocessor developed to handle communications with a subsea pressure sensor package and ARGOS satellite transmitter.

The pressure sensor package samples and stores data continuously to make 30-minute averages and daily makes and stores a 12-minute period of 15 second (sampled) data. These data are telemetered to the surface on command from the buoy system and stored in the buoy processor package. Data are then transmitted via satellite and received for analysis at PMEL.

The preliminary results from this experiment are encouraging and confirm the design of the system. A tsunami wave monitoring system is an obvious application of this developing technology. When deployed in the deep ocean, these systems would monitor minute changes in (tsunami) wave height and telemeter those data via the surface buoy and satellite to tsunami warning centers.

Mike Blackford Visits Papua New Guinea

While on an invited trip to attend a national tsunami workshop in Australia in August 1994, Mike Blackford (Geophysicist-in-charge at PTWC) made a side trip to visit the Geophysical Observatory at Port Moresby, Papua New Guinea (PNG). Horst Letz, Director of the Geophysical Observatory, hosted Mike's two-day visit in PNG.

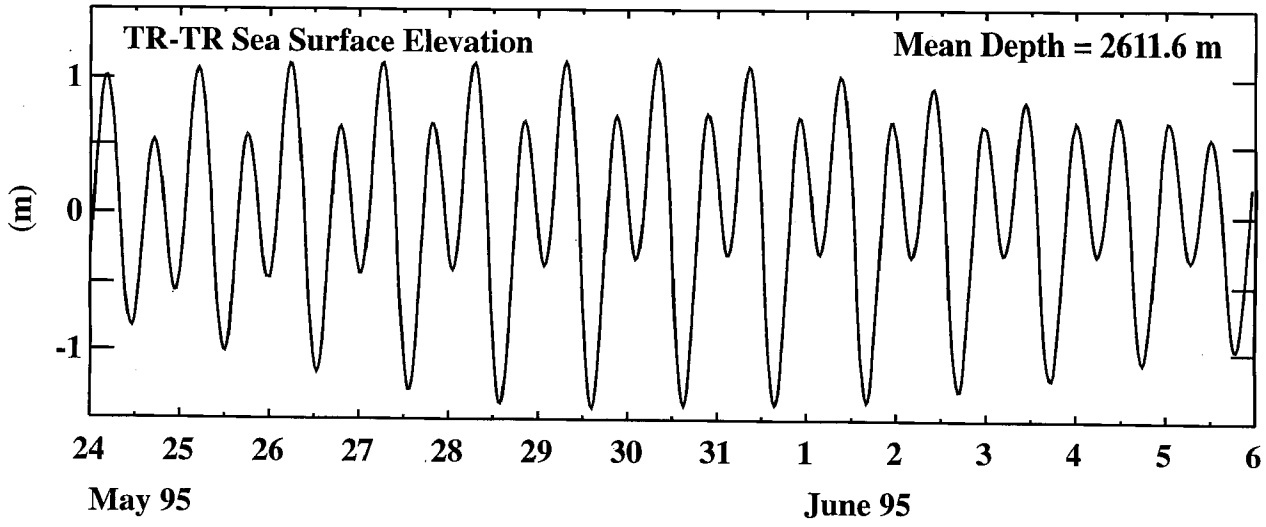
Although the primary purpose of the trip was to meet with the observatory officials and discuss the national seismic and water level programs, it was hoped the visit would generate interest in PNG to join the ICG/ITSU. PNG is located in an area of high seismicity with the possibility of local tsunamis being generated by nearby earthquakes or explosive volcanic eruptions. Our readers will recall the violent eruptive activity that caused extensive damage to the harbor city of Rabaul in September and October of last year.

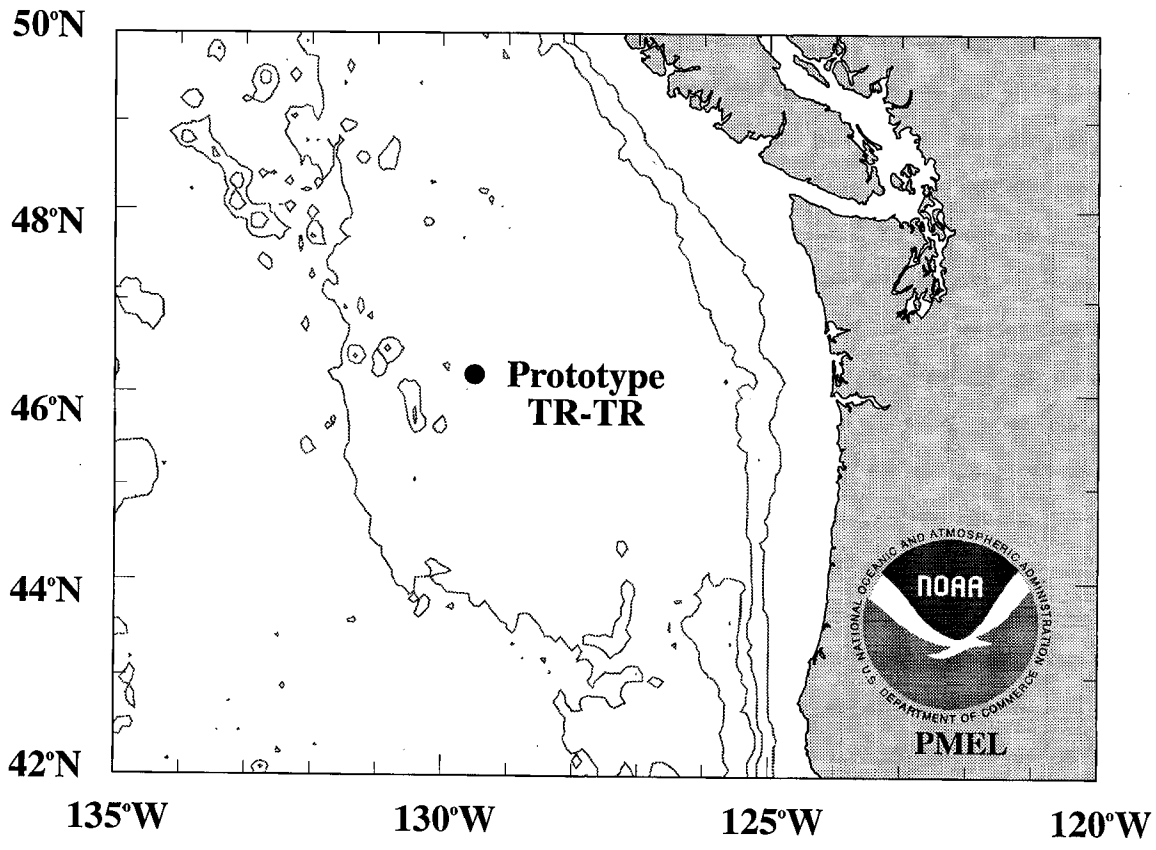
Tsunami Awareness in Micronesia

The topic of Tsunami Awareness in Micronesia will be a focus of interest for the US National Weather Service, Pacific Region's Ocean Services Program Coordinator Patrick Gajdys. He will be visiting Micronesia to conduct tsunami awareness training (by the end of 1995) and review tsunami warning procedures in each government and state. Additionally, he will assess the general public's level of concern and awareness for tsunamis that might affect their islands. The Ocean Services program handles much of the Pacific Region's marine and oceanographic issues.

A large portion of the information to be used for assessing the level of concern for tsunami awareness will come from the maritime community. This will include the commercial shipping companies but will equally focus on the local island fishing and maritime population, and emergency management. Information and data on tsunamis in Micronesia is sparse when compared to many other areas in the Pacific. This emphasizes the importance of the need for local communities input to the effectiveness of the tsunami warning program in Micronesia, and to insure island communities are fully prepared for potentially destructive local and Pacific wide tsunamis.

Test Deployment of Prototype
Tsunami Real-Time Reporting System





Deep ocean pressure gauge mooring - prototype tsunami reporting system (TR-TR) off the Washington USA coast. Data from the system reduced to display the daily tidal cycle.

The NWS, Pacific Region Ocean Services office will work closely with ITIC and PTWC to ensure information messages are distributed in Micronesia. Patrick Gajdys welcomes any ideas and suggestions on methods and approaches that might be effective in addressing the concerns of the people of Micronesia. He hopes to visit many of the main islands and to meet with the local maritime and civil defense organizations later this year. The plan will be to learn first hand the current level of tsunami awareness and to present any types of educational and informational items that may be currently available. In return he hopes to provide feedback to the Pacific Tsunami Warning Center and the International Tsunami Information Center on suggested methods that could improve tsunami warning and information services to Micronesia.

Ocean Services Program Coordinator, NOAA
Box 50027
Honolulu, HI 96850-4993
FAX: (808) 541-1678
Internet: pgajdys@smtpgate.ssmc.noaa.gov

Asian Disaster Preparedness Center - Bangkok, Thailand

The Asian Disaster Preparedness Center (ADPC), Asian Institute of Technology - Bangkok, Thailand, has the role of assisting countries in Asia and the Pacific Region in developing their policies and capabilities related to disaster management. This role is pursued by means of promoting the broadest awareness and understanding of disaster hazards and related risks to the well-being of people, their communities and their resources. ADPC promotes the informed and practical application of management, technical abilities and research from within the region to enhance the effectiveness of hazard risk reduction. The work of the ADPC is based upon those relationships which exist among disasters, the environment, and national development aspirations. ADPC is offering a series of disaster-related management courses and workshops during 1995. Interested parties may contact Gunilla Gustafs, Information Officer - ADPC, at Internet: adpc@cs.ait.ac.th or by Fax: (66-2)524-5360, for further information on ADPC and forthcoming programs and training.

Communication Systems in Ecuador and the TWS

The Pacific Tsunami Warning System (TWS) uses a mix of old and new technology communications equipment to collect seismic and water level data and for the dissemination of tsunami watch, warning and information bulletins. A review of these systems and associated problems in disseminating tsunami warning bulletins will be discussed in detail at ITSU-XV in Papeete. A recent communication from Ecuador's Instituto Oceanografico de la Armada (INOCAR) has asked PTWC to assist in finding the most efficient method for communicating tsunami alerts between PTWC and INOCAR. Unfortunately, this request is similar to experiences from other Member States who report dissemination delays while using standard communication circuits such as the GTS and AFTN. ITIC and PTWC are making every effort to ensure the timely dissemination of bulletins using existing technology systems as well as to evaluate and propose for testing/implementation alternate communication techniques that will speed the dissemination of tsunami alerts to all Member States. All Member States are encouraged to continue documenting problems associated with delays and inaccuracies in receiving tsunami bulletins by sending discrepancy reports to either PTWC or ITIC.

Singapore to Install Seismic Stations

It has been noted that Singapore is installing up to five seismic stations to monitor earthquakes in the region. The installation of the equipment is expected to be completed by early 1996; there is currently no seismograph equipment in Singapore to measure earthquake activity. According to the Singapore Meteorological Service, Singapore wants to contribute to the regional monitoring programs in the area. The system that Singapore intends to acquire will expand the present network of seismic stations in the region. Presently, Indonesia, Malaysia, the Philippines and Thailand have seismic monitoring stations.

Mexico to Install Broad-Band Seismic Stations

The CICESE Research Center at Ensenada (Mexico) is installing five broad-band seismic stations around the Gulf of California coast to monitor earthquakes in the region and obtain information to help define seismic risk standards. The stations will have instruments similar to the U.S. Terrascope equipment, and each one will be equipped with: one 3-component long period (0.001 to 600 hertz frequency) seismometer and one 3-component accelerometer. The information will be recorded with 24-bit resolution in a solid state memory and retrieved later on by a portable computer. Real-time transmission via satellite will be considered for a later stage of the project, after 1996. The first station is expected to be installed by November 1995. These five Gulf of California stations will become part of a national network of 35 broad band stations, the other stations to be installed by the National Seismological Service of Mexico. This project has the support of the National Council on Science and Technology of Mexico (CONACYT) and the World Bank.

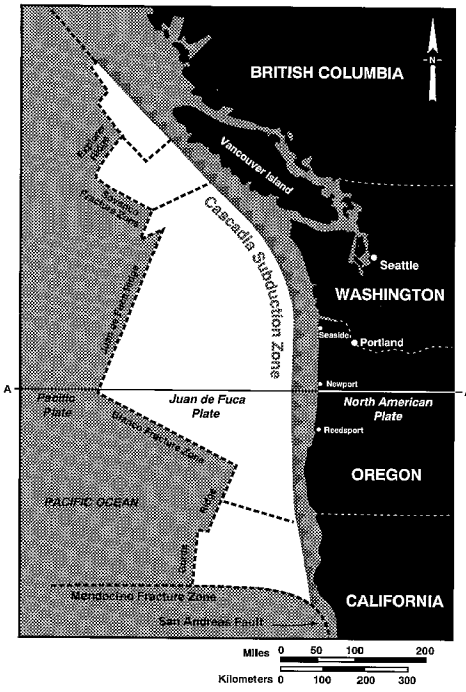
NOAA Conducts Tsunami Education Planning Workshop

The National Oceanic and Atmospheric Administration (NOAA) is developing a plan to reduce tsunami hazards along the coasts of the United States, with particular emphasis on the west coast. Public education is a key component of the plan. To identify important public education needs, NOAA's Pacific Marine Environmental Laboratory, Oregon Sea Grant, the

Tsunami

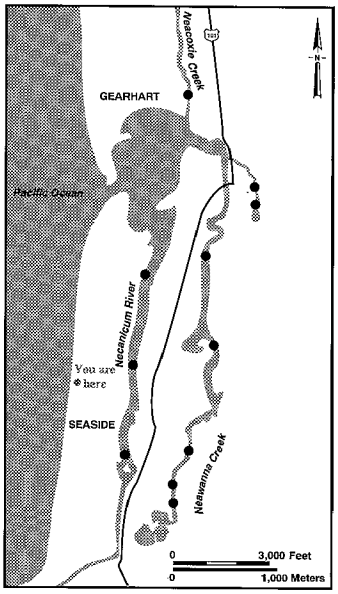
Seaside

Devastating waves called "tsunamis" can strike the Oregon coast at any time. Most tsunamis are caused by great undersea earthquakes. Such earthquakes occur along the Cascadia Subduction Zone, one of the largest active faults in North America.

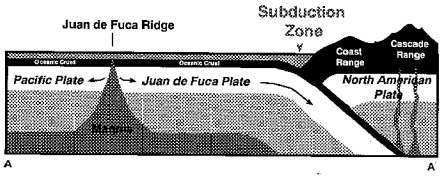


Tsunamis are dangerous and destructive. Cascadia tsunamis have struck the Oregon coast several times in the past 2,000 years. Most recently, about AD 1700, a tsunami caused by an earthquake on the Cascadia Subduction Zone flooded beaches, tidal channels, and marshes up to one mile inland from Seaside's present-day boardwalk. This tsunami and earlier ones are known to have affected large areas because tsunami-deposited sand has been found here in Seaside and in other coastal lowlands in Oregon, Washington, British Columbia, and northernmost California.

◄ The earth's surface consists of a series of "plates." These plates are constantly shifting and sliding over, under, or past each other. When a sudden movement occurs between two plates, we experience an earthquake.



A tsunami can deposit a layer of sea sand in its path. Core samples have been collected along the Necanicum River and the surrounding lowlands for evidence of past tsunamis. Dots show where buried tsunami sands were found. ►



◄ The Juan de Fuca Plate is moving away from the Juan de Fuca Ridge and is being forced under the overriding North American Plate; this geologic process is called subduction.

WHAT TO DO

If there is an earthquake on the Cascadia Subduction Zone, Seaside could be hit by a tsunami within minutes of the ground shaking. To escape a tsunami, you must respond immediately after feeling an earthquake — go to high ground away from beaches, tidal channels, and other coastal lowlands. Remember, most tsunamis are not solitary giant waves; instead, many large waves may strike shore over the course of several hours. Do not return to the beach after the first tsunami wave. Wait for official word from authorities. For additional information contact your local emergency planning office or the Oregon Department of Geology and Mineral Industries.

International Tsunami Information Center, and the Alaska Tsunami Warning Center jointly convened a Tsunami Education Planning Workshop on October 26 & 27, 1994 in Newport, Oregon.

The workshop group concluded that major and minor population centers, coastal industry, ports and harbors, and other major infrastructure on the U.S. west coast are increasingly vulnerable to potentially destructive tsunamis. Further, they agreed that broad-based public education is one of the most effective means for reducing risks of loss of both life and property at risk of this hazard. The group noted that, although the focus of the planning is on tsunamis, the tsunami element is but one component of an all-hazards education program that should include other related seismic hazards. Persons interested in obtaining more information on this planning effort are asked to contact ITIC.

Geologic Markers Show Tsunami History and Safety Rules in Oregon, USA

A series of geologic markers describing tsunamis and their occurrences are being placed along various coastal locations in the state of Oregon. Funded by state government, the multicolor sign explains how and why tsunamis periodically strike the Oregon coast. The purpose of the signs is to familiarize the public with the tsunami risk along the Oregon coast and to provide realistic information about the evidence and extent of this natural hazard. For each sign location, geologic evidence of pre-historic tsunamis found in the area is pictured and described in detail. An example marker placed in the Seaside community area is shown (courtesy DOGAMI & Sea Reach Ltd.) If you are interested in finding out more about these signs please contact ITIC or the Oregon Department of Geology and Mineral Industries (DOGAMI) in Portland, Oregon; fax: (503)731-4066.

Tsunami Essay Contest in Hawaii

The Hilo Tsunami Museum, a non-profit organization, is moving ahead with plans to establish a museum in Hilo that will provide a focus on tsunami education, local history, exhibits and research programs (see related article).

A recently sponsored "tsunami essay" contest for school children on the Island of Hawaii by the Museum brought in a number of interesting entries by 5th grade students. The top five entrants talked about memorable accounts of tsunamis on the Island of Hawaii that have claimed countless lives and caused significant destruction of property. One of the winning entries was written in the native Hawaiian language. Winning contestants received prizes for their efforts. The Hilo Tsunami Museum is achieving its goals with projects like this that involve the local community by stimulating discussion and awareness of the tsunami hazard.

Tsunami Investigation in the Black Sea

This report was submitted by Prof. Sergey F. Dotsenko, Department - Theory of Waves, Marine Hydrophysical Institute, Crimea, Ukraine.

The investigation of extreme hydrophysical events in the Black Sea has begun within the framework of a new 7-year Ukrainian project, "Marine Hazards." The project was created by the National Agency of Marine Research and Technology in the middle of 1994. Tsunami and seismic activity, storm surges, anthropogenic pollution, dynamics of hydrogen sulfide contamination (unique natural phenomena) in the Sea are the objects of the study. Selection and analysis of data, hazard mapping and mathematical modeling of processes are in progress now at the Marine Hydrophysical Institute (Sevastopol), the Institute of Geophysics (Kiev), the Institute of Hydromechanics (Kiev) and other institutions in the Ukraine.

More than 10 tsunamis of seismic origin have been located in the Black Sea during last twenty centuries. At least three prehistoric tsunamis were destructive. Only tsunamis in 1927 (2 events), 1939 and 1966 were recorded by water-level gauges located along the coastline of the Sea. Tsunamis were weak at the observation points where the heights of the waves did not exceed 52 cm, however, wave heights reached 2 m in some bays. The 1927 tsunami passed through the narrow Kerch Strait, and water-level gauges recorded oscillations in the Sea of Azov. The tsunami of 1939 was generated by the well-known great Erzincan earthquake in Turkey with the epicenter outside the Sea.

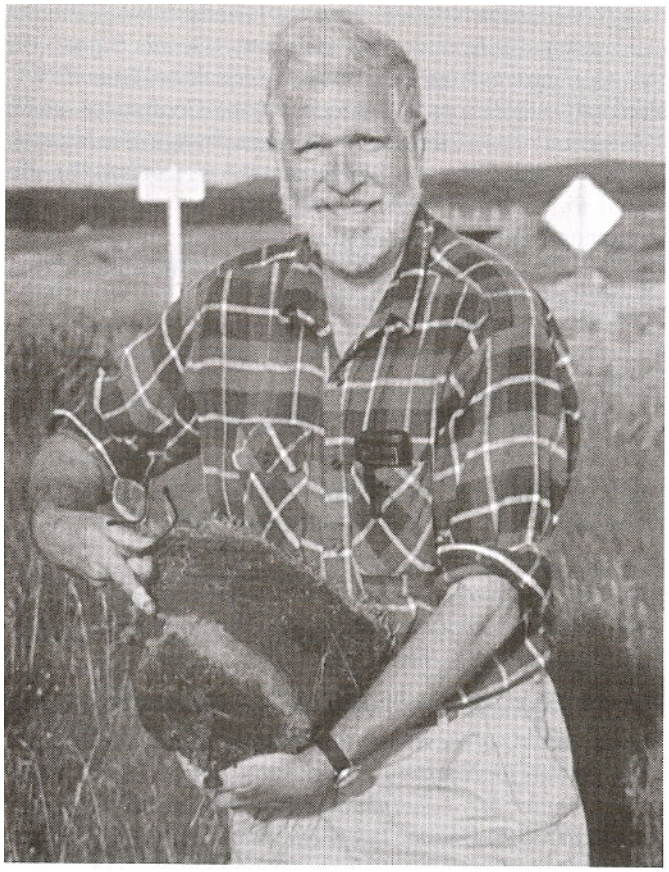
Ray and long-wave models were developed for numerical simulation of historical and feasible tsunamis in the region. The closure of the basin leads to simplification of the model because open boundary conditions are not required. On the other hand, multiple reflections from and trapping by coastal the zone involve difficulties with interpretation of the results.

The international experience of tsunami research in the Pacific has been used for development of a tsunami hazard national program. *ed. We appreciate receiving this and the following interesting report on tsunami projects outside of the Pacific Basin.*

Re-discovery of a 1929 Tsunami through old Sand Deposits

A study by Alan Ruffman (Geomarine Associates Ltd., Halifax, Nova Scotia, Canada); Martitia Tuttle (Dept. of Geology, Univ. of Maryland, USA; and Thane Anderson, Geological Survey of Canada, Ontario, Canada)

During a site investigation at Taylor's Bay, Newfoundland, Canada, a unique sand layer, interpreted as a 1929 tsunami deposit, was found at depths 4 to 5 cm in peat deposits adjacent to and behind a tidal pond. Pb-210 dating of the sedimentary section indicates that the sand layer was deposited in 1930±8 yr. Analysis of the littoral diatoms and pollen assemblages content in the tsunami deposit indicates



Alan Ruffman pointing proudly to the tsunami-laid sand layer in the dark peat found at Taylor's Bay on the Burin Peninsula of Newfoundland, Canada. Alan is standing on the flat peat 'meadow' that lies behind a tidal pond and a barrier beach of sand at the head of the bay.

that the sand was moved onshore from a marine environment.

The tsunami deposit ranges up to 25 cm in thickness, and in some places fines upward from a coarse sand with few granules to a fine sand; the basal contact is abrupt and reflects the pre-tsunami peat, while the upper contact is less distinct due to bioturbation (see photo this page).

The hypocenter of the 'Grand Banks' earthquake of 18 November 1929 (Ms = 7.2) was located 350 km south of Newfoundland, 18 km beneath the Laurentian Slope at a water depth of 2,000 ffi. The Geological Survey of Canada has determined that this event was the result of a right lateral strike-slip rupture progressing to the northeast on a NE-SW trending fault. Offshore, the ocean floor part of the Laurentian Slope was shaken loose and began an underwater landslide that flowed 1,500 km out onto the floor of the Sohm Abyssal Plain. The turbidity current and submarine slump cut twelve trans-Atlantic telegraph cables and spawned a tsunami that traveled at about 140 km/hr over the continental shelf and struck with 7 m waves along the south coast of Newfoundland at the heads of the long narrow bays on the Burin Peninsula, before refracting counterclockwise around the Avalon Peninsula and affecting northeast Newfoundland. This study has identified this tsunami, determined its wave heights of 3 to 7 m in various sites, its horizontal extension of inundation of 10,000 m^2 at Taylor's Bay and about 1,000 m^2 at Lamaline, the fact that there were three main pulses, and the fact that the tsunami refracted counterclockwise around the Avalon Peninsula.

The ideal conditions to create and to capture a tsunami-laid deposit appear to require a very nearshore or beach source of sand, a back-beach pond to capture storm overwash, and a low flat marsh $_{Q}$r peat bog 'meadow' shoreward of the pond to trap the slurry of fine sediment swept in by the tsunami.

Results of these and other studies suggest that tsunami deposits can be distinguished from storm deposits based on areal distribution and sedimentary structures. The tsunami deposits are found at higher elevations (above the height of the barrier beach) and at greater distances from the shoreline than the storm deposits. In addition, the tsunami deposits can be found inland from tidal ponds; whereas, the storm deposits rarely occur. The tsunami deposits are characterized by few layers of massive or fining upward sediments; whereas, the storm deposits are often interbedded and characterized by cut-and-fill structures. Comparisons of these and other tsunami and storm deposits will help to develop criteria for identifying and interpreting paleotsunami deposits in the geologic record.

Evidence of Large Past-Tsunamis in the Cascadia Subduction Zone of Canada and the U.S.

A study by John Clague (Geological Survey of Canada, Vancouver, British Columbia, Canada), and Peter Bobrowsky (Ministry of Energy, Mines and Petroleum Resources, Victoria, British Columbia, Canada), condensed from journal articles received at ITIC.

Continuing studies of sedimentological characteristics of sand sheets deposited beneath tidal marshes infer a tsunami origin. In the Canadian study area, three sheets of sand occur within Holocene mud and peat deposits beneath tidal marshes at Tofino, Ucluelet, and Port Alberni on Vancouver Island, B.C. The sheets are extensive, have sharp upper and lower contacts and consists of moderately sorted massive and silty sands, with abundant wood and plant detritus.

$^{137}C_S$ analysis suggest that the uppermost, and thinnest, sheet was deposited by the tsunami triggered by the great Alaska earthquake in 1964. The intermediate sheet has been radiocarbon dated between 100 and 400 years ago. Foraminifera and vascular plant fossils rooted in the upper part of the peat extend into and through the overlying sand, suggesting that the buried soil was submerged suddenly and was covered quickly by sand. The former marsh surface probably subsided suddenly during a large earthquake and the sand was deposited by a tsunami

generated by this earthquake. Farther south along the coast, similar stratigraphic sequences of about the same age have been reported from estuaries along the outer coasts of Washington and northern Oregon, USA, suggesting that hundreds of kilometers of the Cascadia subduction zone may have ruptured during one, or a series of plate-boundary earthquakes less than 400 years ago.

The lowermost sheet is 500 to 800 years old. The tsunami that deposited it may have been caused by a previously unrecognized earthquake on the Cascadia subduction zone, or a large submarine landslide, or the penultimate great subduction earthquake in southern Alaska, dated between 700 and 950 years ago.

The results of this study suggest that large tsunamis have struck southern British Columbia, Washington and northern Oregon coasts several times during the late Holocene and that some were much larger than the 1964 Alaska tsunami. This geologic evidence is consistent with geophysical data that suggests a section of the Cascadia subduction zone is locked and accumulating strain, so that tsunamis which may pose a hazard to people and property in some coastal areas can be expected in the future.

MEETING REPORTS AND ANNOUNCEMENTS

Tsunami Measurements Workshop

An international workshop on "Tsunami Measurements," organized by J. F. Lander and H. Yeh, was held in Estes Park on June 29-30, 1995. It considered a number of questions arising from the recent destructive tsunamis and new technology. Among the questions addressed were the need for international teams to visit the site of destructive tsunamis to maximize learning from them, problems with the collection, distribution, and archiving of tsunami data, the adequacy of water height instrumentation for tsunami applications, the adequacy of models for source studies, runup mapping and real-time wave height prediction, and potential gaps in research. A draft of the recommendations will be presented at IOC/ITSU-XV. The recommendations will be published and their implementation tracked.

Pacific All Hazards Conference, Honolulu

The State of Hawaii - Department of Civil Defense and the US Federal Emergency Management Agency co-hosted a three-day conference in Honolulu to discuss natural hazards throughout the Pacific Insular State area. The early June 1995 conference brought together representatives from the Federated States of Micronesia, Republic of Palau, Republic of the Marshall Islands, American Samoa, Government of Guam, the Commonwealth of the Northern Mariana Islands, Hawaii, Alaska and participants from the US mainland. Dennis Sigrist and Salvador Farreras from ITIC and Mike Blackford from PTWC attended the meetings. The focus of the Conference was a "Mitigation Forum" that explored a broad range of mitigation issues impacting the area, including the tsunami threat. In regard to tsunami-related matters, there was discussion on improving (timely) dissemination of tsunami bulletins to the area as well as providing education support to increase tsunami awareness among the local population.

UPCOMING MEETINGS

International Workshop on Earthquake Disaster Reduction in Urban Areas

June 28-30, 1995

note: ITIC received notification of this important meeting at press time and apologizes for the post-announcement.

Wisata International Hotel, Jakarta, Indonesia

Jointly organized by the Meteorological and Geophysical Agency (MGA) of the Republic of Indonesia, and the International Decade for Natural Disaster Reduction (IDNDR) Secretariat. Contact: Mr. J. Sutijanto, Jl. Angkasa I # 2, Kemayoran, Jakarta 10720, Indonesia; Telephone: 0062-21-424-1169; Fax: 0062-21-424-6703; e-mail: suhard@mimo.bppt.go.id

The objective of the workshop is to further international cooperation in earthquake disaster reduction in urban areas within the framework of the IDNDR and to identify common priority areas for urban earthquake disaster reduction in the second half of the Decade. The meeting will focus on seismological and engineering aspects of earthquake disaster reduction, with particular emphasis on urban areas in developing countries. Special sessions will review recent urban earthquake disasters, in particular the Hyogo-ken Nambu earthquake of 17 January 1995 in Japan.

IAPSO XXI General Assembly

August 5-12, 1995

Tapa Conference Center of the Hilton Hawaiian Village, Honolulu, Hawaii, USA

Local Organizing Committee:

Dr. Douglas S. Luther, Chairman, Department of Oceanography, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa, 1000 Pope Road, MSB 307, Honolulu, Hawaii 96822, USA. Fax: 808-956-9165. Internet: dluther@iniki.soest.hawaii.edu

For registration, hotel accommodations, and transportation, contact: Arlene Davie, Executive Vice-President of Travel Planners, Inc., Suite 150-GPM Bldg, San Antonio, Texas 78216-5674, USA. Telephone: 210-341-8131, Fax: 210-341-5252.

UPCOMING MEETINGS

For those interested in tsunamis, Symposium PS-05: "Coastal Ocean (B), Interaction with the Adjacent Land" will focus on the circulations and processes in the coastal oceans, especially those having connections or interactions with the land. Problems of estuaries, studies of natural hazards in the coastal zone including storms and *tsunamis*, and presentations on the mitigation of these hazards will be included.

In keeping with the theme of the symposium, tsunami-related papers should address effects, e.g., coastal flooding and hazards, protection, and other mitigation measures. For information on Symposium PS-05, contact:

Dr. Fred Camfield , Corresponding Convenor
Coastal Engineering Research Center
Waterways Experiment Station
U.S. Army Corps of Engineers
3909 Halls Ferry Road
Vicksburg, MS 39180-6199, USA
Telephone: 601-634-2012
FAX: 601-634-3433
e-mail: camfield@coafs1.wes.army.mil

A visit to the Pacific Tsunami Warning Center facilities at Ewa Beach is planned.

The Tsunami Society

August 9, 1995
Hilton Hawaiian Village, Iolani Room 1
Contact: Dennis Sigrist (ITIC)

The Tsunami Society will be conducting a general meeting for all its members and interested individuals during the IAPSO General Assembly in Honolulu at the Hilton Hawaiian Village. In addition to election of new officers, the question of where to locate the office of the Society will be addressed. The meeting is scheduled during the noon-hour on Wednesday, August 9.

Coastal Earthquakes and Tsunamis - Reducing the Risks

August 29-31, 1995.
Seaside Convention Center, Seaside, Oregon, USA

Contact: Jay Charlan, Oceanography Administration Hall 104, Oregon State University, Corvallis, Oregon 97331-5503, USA, Telephone: 503-737-1340, Fax: 503-737-2064; e-mail: jcharlan@oce.orst.edu

The Oregon Department of Land Conservation and Development and the Oregon Extension Sea Grant Program are convening this Pacific Northwest regional Conference. It is being held as a forum for discussion and exchange of information among scientists, land developers and planners, insurance and finance specialists, elected officials, emergency managers and planners, port and waterfront operators, and affected property owners.

The goals of the Conference are to disseminate current scientific information on Cascadia Subduction Zone earthquakes, to share results of recent coastal hazards reduction projects, and to identify and discuss management and policy options to reduce the risk to coastal communities from a major earthquake and tsunami. The Conference will emphasize risk reduction through land use and infrastructure development decisions.

Coastal Engineering 95

September 6-8, 1995
Cancún, México

Convener: L. Johnstone, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, S040 7AA, U.K.; telephone 44-703-293-223, FAX 44-703-292-853, e-mail: cmi@ib.rl.ac.uk

Computer modeling of seas and coastal regions under normal and extreme conditions, with a special emphasis on practical applications currently being used internationally will be addressed. Conference topics include shallow water models; pollutant transport and dispersion; wave propagation; sea defense and protection systems; coastal erosion; underwater dunes; and *tsunamis*, storm surges, and typhoons.

International Workshop on Long-Wave Runup Models

September 12-16, 1995.
Friday Harbor, San Juan Island, Washington, USA

Organizing Committee:

Philip Liu	*plliu@bridge.tn.cornell.edu*
Costas Synolakis	*costas@mizar.usc.edu*
Harry Yeh	*harryeh@u.washington.edu*

The objectives of the Workshop are to review the research progress in tsunami runup, to compare numerical, analytical, and physical prediction models with existing laboratory experimental and field data, i.e. benchmark problems, and to identify future research directions in tsunami hazard mitigation. A special session will also be arranged to discuss field observations of recent tsunamis: Nicaragua, Flores, Okushiri, East Java, South Kuril, Mindoro, and Skagway.

The format of the Workshop stresses discussions rather than formal presentations. Four detailed benchmark problems: 1) wave packet propagation along a sloping beach, 2) interaction of incident waves with a conical island, 3) wave runup on a composite beach, and 4) wave runup around Okushiri Island; to be solved by numerical, analytical, or experimental modeling, were initially distributed among 37 potential participants, by January 1995. They were encouraged to present their results in various forms, e.g. computer-graphic animation, three-dimensional contour plots, parameterization of complex results, and simplified prediction formulae.

UPCOMING MEETINGS

Their write-up should be submitted to the organizing committee no later than August 1, 1995, so that the results can be distributed to all participants prior to the workshop with sessions time spent in detailed discussions and clarifications of the models. Satisfaction of this last requirement is needed to become one of the invited participants.

The workshop is sponsored by a grant from the National Science Foundation of the United States and is open to all researchers around the world.

Seismology and Seismic Hazard Assessment Course

October 22 to December 3, 1995
Ticomo Hotel, Managua, Nicaragua

Jointly organized by:
Instituto Nicaraguense de Estudios Territoriales (INETER), Secretariat of the Seismology Training Course, c/o Dr. W. Strauch, Apdo. Postal 761, Managua Nicaragua, Phone/ Fax: 505-2-496987, e-mail: wil@ineter.ni; and

GeoForschungsZentrum Potsdam (GFZ), c/o Prof. Dr. P. Bormann, Telegrafenberg A34, D-14473, Postdam, Federal Republic of Germany, Phone: 49-331-288-1523, Fax: 49-331-288-1527, e-mail: course@gfz-postdam.de

A six-weeks regional international training course, for the benefit of participants from Latin America and Caribbean countries, that will cover topics of seismometry, seismological data acquisition and analysis, wave propagation and structure of the lithosphere, seismic source parameters and processes, seismicity, seismic zoning, earthquake statistics and hazard assessment, strong motion effects and microzonation, volcano and *tsunami* monitoring and warning, and earthquake prediction research.

The course program aims at developing interdisciplinary problem understanding, acquainting with the theoretical fundamentals and basic assumptions of commonly used instrumentation, models and algorithms as well as the development of practical skills in data analysis, evaluation and problem solving. Lectures on the various subjects will be followed by extensive practical exercises and workshop discussions and complemented by reviews and scientific field excursions to a nearby volcano, seismic stations, and the Pacific coast devastated by the 1992 *tsunami*. One day of lectures will be devoted to discuss *tsunami* hazards, modeling, specific cases in Latin America, PTWC operational procedures, warnings, and public response.

Applicants must have a scientific degree (BSc.,MSc., or diploma) in geosciences, physics, or engineering, and a thorough knowledge of English which will be the only working language of the course. Preferably they should have several years of professional experience in subjects covered by the course.

Annual Meeting of the Mexican Geophysical Union

November 13-17, 1995
Puerto Vallarta, Jalisco, Mexico

Sponsor: Mexican Geophysical Union. (F.Medina,IGF-UNAM, PO Box 189003, 1415 Fourth St., Suite 002, Coronado, CA 92178, USA; Tel: 52-617-44602, Fax: 52-617-44603; e-mail: ugfmex@cicese.mx)

Session topics will include: seismology, pure and applied geophysics, exploration geophysics, tectonics, volcanology, structural geology, hydrology, petrology, atmospheric sciences and climatology, marine sciences and oceanography, planetary sciences, and space physics.

Abstract deadline is September 10, 1995.

International Symposium on Spectral Sensing Research

November 26 - December 1, 1995
Regent Melbourne Hotel
25 Collins Street, Melbourne, Victoria 3000, Australia

For information contact:
Judy Cole, ISSSR Symposium Coordinator, Science and Technology Corporation (STC) Meetings Division, 101 Research Drive, Hampton, Virginia 23666-1340, USA; Phone: 804-865-7604, Fax: 804-865-8721

The objective of the Symposium is to provide an international forum where people can meet to discuss scientific requirements, implementation issues, analysis problems, and scientific benefits of spectral sensing research.

The theme of the Symposium is **"Crisis Support"**, including in this context environmental concerns such as *prevention, assessment, and monitoring of natural disasters,* oil spills, ozone depletion, etc. Among the topics to be addressed are: Data collection (sensors and sensor system/platforms, field and laboratory measurements, and data bases), Oceanographic/ coastal studies and applications, Terrestrial and land surface studies (stressed vegetation detection, etc.), and Crisis support and disaster studies (land utilization, flood damage assessment, and flood control monitoring).

Natural Disaster Reduction '96

March 5-8, 1996
Washington D.C., USA

Organized by: Conferences and Conventions Department, American Society of Civil Engineers(ASCE), 345 East 47th Street, New York, NY 10017, USA

The objective of this Conference and Exposition is to promote and assess the role of civil engineering, through its interaction

with other engineering disciplines, sciences, and others, in preventing, mitigating, preparing for, and recovering from *natural disaster* impacts on the built and natural environments, including socio-economic, political, public health, and institutional considerations.

Suggested topic areas are: hazard identification, vulnerability assessment, risk management, mitigation, education, institutional issues, and response and recovery.

The conference will feature plenary and concurrent session presentations, a poster session, panel discussions, informal roundtables, and an exposition which will serve as an integral component of the conference learning experience. Potential exposition exhibitor-types include: designers, manufacturers, and suppliers of disaster reduction equipment, instruments, devices, software, etc. Deadline for submitting abstracts: September 15, 1995.

Tsunami 1996 Conference and Museum Inauguration

April 1-2, 1996
Hilo, Hawaii, USA

Organizing Committee Co-Chairmen:
Jim Lander, University of Colorado, USA;
jlander@ngdc.noaa.gov
George Curtis, University of Hawaii;
gcurtis@uhunix.ohcc.hawaii.edu
Hilo Tsunami Museum, P.O. Box 806, Hilo, Hawaii 96721

Marking the 50th anniversary of the 1946 tsunami at Hilo, which led to the present Pacific-wide warning system, increased tsunami research, and the Centennial of the great Sanriku earthquake and tsunami in Japan, a Conference is planned. It will review the lessons learned, the progress made, the things still to be accomplished, and priorities needed for tsunami and similar hazards mitigation. An open house and tour to the Pacific Tsunami Warning Center on Oahu will be available.

Simultaneously, a grand opening of the Hilo Tsunami Museum will take place. The Museum will provide public education programs that will increase tsunami awareness, and will integrate local oral history with scientific information. To achieve its goals, the Museum will have permanent and temporary exhibits, living history "talk sessions", and in-house and out-reach educational programs. The Museum, a private non-profit organization, needs financial support. Please contact the address shown above to send your tax deductible donation. The 4th UJNR Tsunami Workshop is planned also for the same date and place.

3rd Congress on Numerical Methods in Engineering

June 3-6, 1996
Boston Hotel, Zaragoza, Spain

Organizer:
Spanish Society of Numerical Methods in Engineering (SEMNI)
Edificio C-1, Gran Capitán s/n, 08034 Barcelona, Spain; Telephone: 93-401-7441, Fax: 93-401-6517

The objective is to provide a forum to discuss and exchange opinions and experiences on the most relevant and recent developments on basic research and applications of numerical methods to engineering and sciences. Topics expected to be covered are: finite differences, finite elements, and contour elements algorithms, parallel computer techniques; and their applications to: aerodynamics, structural mechanics, soil mechanics, hydraulics, fluid mechanics, and oceanography, among others.

Deadline to submit abstracts: October 16, 1995.

7th Pacific Congress on Marine Science and Technology

(PACON '96)

June 16-20, 1996
Ilikai Hotel, Honolulu, Hawaii, USA

For registration and information contact: Dr. Narendra K. Saxena, e-mail: saxena@wiliki.eng.hawaii.edu; and/or PACON International, P.O. Box 11568, Honolulu, Hawaii 96828, USA; Telephone: 808-956-6163, Fax: 808-956-2580

Theme: the role of marine science and technology in the economic development of the Pacific Basin resources. This Congress will bring together scholars and resource people to address key issues concerning the marine technology related to the ocean economic potential of the region from a multi-disciplinary perspective. It will facilitate the exchange of views and ideas between representatives of the Pacific Island nations and of the larger rim countries and thereby strengthen future information exchange and collaborative research linkages.

Session topics include: remote sensing and oceanography satellites, marine applications of GPS, *tsunamis*, marine environmental protection, undersea vehicles and ocean robotics, and effects of hurricanes and typhoons in the coastal areas. An exhibition will be held in conjunction with the technical program.

Abstracts must be received no later than January 15, 1996.

PUBLICATIONS

A Conference on Earthquakes Volcanoes and Tsunamis

Pan Pacific Hazards '96

July 29- August 2, 1996
Vancouver Trade and Convention Centre, Vancouver, B.C., Canada

Submit abstracts to: Program Committee, Pan Pacific Hazards '96 Conference, The University of British Columbia, Disaster Preparedness Resources Centre, 2206 East Mall, 4th Floor, Vancouver BC V6T 1Z3, Canada; Phone: 604-822-5518, Fax: 604-822-6164, e-mail: dprc@unixg.ubc.ca; For information contact: Conference Secretariat, Phone: 604-822-6002

A Conference on Earthquakes, Volcanoes, and *Tsunamis*. The following areas will be covered in bridging research/ technical, emergency management, and practical application aspects of earthquakes, volcanoes and *tsunamis*: disaster preparedness, public education and awareness, risk assessment, prediction and forecasting natural events, monitoring and warning systems, communication technologies and networks, disaster response and recovery, and hazard mitigation, among others.

The purpose of this Conference is interdisciplinary, so in addition to technical sessions within specialty areas, participants will be asked to listen to issues and concerns raised by others as well as contributing to the search for answers. The Conference will go beyond conventional discussion of response stories and risk analysis to explore strategies for preparedness and mitigation. To enhance interdisciplinary information sharing, it will include: workshops, poster sessions, plenary sessions, panel discussions, technical exhibits, video viewing, technical tours, and public forums.

Deadline for abstracts submission is November 1, 1995.

Natural Disaster Reduction '96

September 29 - October 2, 1996
Brisbane, Queensland, Australia

For information contact: Ms. Shauna Kelly, Managing Director, AE Conventions, Pty Ltd., Engineering House, 11 National Circuit, Barton Act 2600, Australia; Phone: 61-6-2706572, Fax: 61-6-2732918

Aims of the Symposium are: To review both theoretical and practical knowledge of the nature, impact, and mitigation of natural disasters; To provide a forum for government, academic, and business community members, to exchange their experiences and knowledge on natural disasters; To generate state-of-the-art information products to illustrate the scientific and societal response to the threat from natural disasters; and To frame recommendations arising from the deliberations of the Symposium.

Themes for the Symposium are: case studies (bushfires, droughts, cyclones, earthquakes, floods, storms, *tsunamis*, and biological hazards); management/mitigation/recovery (contribution of advanced technology to natural disaster mitigation, and role of the IDNDR and other international programs); social and community issues (role of education in community defense against natural disasters, social and psychological impacts, insuring against disasters, and influence of the media on the perception and mitigation of disasters); and environmentally specific implications (global climate change influence in natural disasters occurrence, linkages between land degradation and natural disasters, and global vulnerability to meteorite impacts). Deadline for abstracts: December 1, 1995.

Publications

Books, Reports, Display Materials and Brochures

3rd UJNR Tsunami Workshop Proceedings

Tanaka, S. and K.Noguchi (editors), September 1994. Technical Memorandum # 3315, Public Works Research Institute, Coastal Engineering Division, River Department, 1, Ashahi, Tsukuba-shi, Ibaraki-ken, 305, Japan; 110 P.

The 3rd Tsunami Workshop of the Task Committee on Storm Surges and Tsunamis of he United States-Japan Conference on Development and Utilization of Natural Resources (UJNR), was held in Osaka, Japan on August 27-28, 1993. The workshop was organized as a series of informal presentations in the main topics, followed by lively discussions. The sessions covered: Numerical Simulation Models, Tsunami Gauge Technologies, and Mitigation and Others. The papers for this publication were written after the workshop to support understanding the proceedings of the discussions, and the report is structured in the same style as the workshop: presentations followed by discussions, for each session.

Inventory of Critical and Essential Facilities Vulnerable to Earthquakes or Tsunami Hazards on the Oregon Coast

Charland J.W. and G.R. Priest, March 1995. Open-File

PUBLICATIONS

Report O-95-02, Oregon Department of Geology and Mineral Industries, 800 NE Oregon St., Suite 965, Portland, Oregon 97232-2162, USA, 52 p. plus 3.5-inch diskette of data.

This report inventories critical and essential facilities in the seven coastal counties of Oregon and determines their vulnerability to serious earthquake damage or tsunami flooding. The inventory covers 47 communities on shorelines within about nine miles of the open coast. It includes such critical and essential facilities as hospitals, schools, fire and police stations, emergency shelters and communication centers, hazardous sites, and major structures-all as they are defined in Oregon law and the Uniform Building Code. Tables show summary estimates of risk from ground shaking and tsunami inundation for individual counties and major communities and comparisons of total existing facilities with those as risk. Also included are estimates of tsunami runup elevations. These data are digitally presented in greater detail on the diskette.

Tsunamis:1992-1994

Satake K. and F. Imamura (editors), 1995. Pure and Applied Geophysics, 144(3/4), Springer Verlag

This topical issue of Pure and Applied Geophysics is not a proceedings volume of any particular meeting, but a collection of 26 papers specifically submitted for this publication. They cover various aspects of recent (1992 Nicaragua, Cape Mendocino, and Flores Island; 1993 Hokkaido Nansei-Oki and Guam; and, 1994 Mindoro Island and Shikotan) tsunamis, such as field survey data and results, seismological analysis; numerical, theoretical, and physical modeling of generation, propagation and coastal behavior, and tsunami deposits. The publication is now in printing process and it is expected to be released by the end of this summer. It will be reprinted as a soft-cover book and make available from the editorial publisher.

Earthquake Planning Scenario for a Great Earthquake on the Cascadia Subduction Zone

1995. California Division of Mines and Geology, P.O. Box 2980, Sacramento, California 95812-2980, USA.

This report presents the results of a recent multi-disciplinary and organizational project to assess the vulnerability of lifelines and major facilities in Northwestern California to a major earthquake on the Cascadia Zone (CSZ). The assessment is based on a regional damage pattern resulting from an earthquake of magnitude M = 8.4 on the Gorda (southernmost) segment of the CSZ.

This segment represents the southern 150 miles of the 750 mile long CSZ, and has the capability of generating a local *tsunami* within a few minutes of the event. The scenario includes a model that estimates seismic shaking intensity, regions susceptible to liquefaction, areas subjected to earthquake-induced landslides, and regions of *tsunami* inundation. The scenario provides emergency planners, policy makers, as well as the general public, with a regional pattern of the types of problems that may be confronted when the southernmost CSZ breaks during a large earthquake.

Earthquakes in British Columbia (brochure)

Geological Survey Branch of the B.C. Ministry of Energy, Mines and Petroleum Resources, British Columbia, Canada.

This colorful illustrated brochure, addressed to the general public, describes and explains what causes earthquakes, where do they occur, what are their effects, and how can the understanding of geology be used to minimize risk. Tectonic plate interaction offshore British Columbia is shown, and a list of major earthquakes and *tsunamis* generated in the past in this region is given. Earthquake induced processes like liquefaction, landslides, and generation of *tsunamis* are described. The 1946 Vancouver Island earthquake (M_S = 7.3) is carefully illustrated as an example.

Improving Natural Hazards Management on the Oregon Coast: Recommendations of the Coastal Natural Hazards Policy Working Group

1994. Oregon Sea Grant, Oregon State University, AdS A402, Corvallis, Oregon 97331-2134, USA, 144 p

With coastal populations rising sharply, the same natural forces – some cataclysmic, some gradual and relentless – that shaped the Oregon coast so attractively over millions of years in the past, now increasingly threaten human life and property. In response to these threats and to concerns that existing efforts to cope with them were inadequate, the Coastal Natural Hazards Policy Working Group, a group of coastal residents and resource managers, identified specific coastal hazard issues, formulated alternative solutions, and recommended improved policies and practices.

In this report, the group identifies 23 issues in four categories: hazard identification, beach and shore protection, land use, and disaster preparedness and response. Following a discussion of each issue is a list of recommendations for resolving it as well as the suggested implementing agencies, organizations, or institutions.

New NGDC Slide Sets Feature Recent Tsunamis

Three recent tsunamis are featured in two new slide sets. The "Major Tsunamis of 1992-Nicaragua and Indonesia" include photos acquired from Harry Yeh in the Department of Civil Engineering at the University of Washington, Seattle. The slide

set shows damage from the two major tsunami events of 1992—the September tsunami along Nicaragua's Pacific coast (6 slides), and the December tsunami in the Flores region of Indonesia (14 slides).

The slides illustrate how a tsunami may affect an area economically and ecologically. The "Hokkaido Nansei-Oki Tsunami, July 12, 1993" slide set shows the results of one of the largest tsunamis in Japan's history. It caused spectacular localized damage, especially on the southwestern shores of Hokkaido and on Okushiri Island. ITIC provided many of the photos in this set which includes views of damage to ships, dwellings, and businesses, and unique views of clocks stopped in time by the tsunami. For further information, contact the US National Geophysical Data Center at 325 Broadway, Boulder, Colorado 80303 USA; FAX: 303-497-6513; INTERNET: info@ngdc.noaa.gov.

ITIC Brochure

The ITIC Brochure, last published in English and Spanish in 1989, has been edited and updated. A French version of the brochure has been printed by IOC and will be available for distribution at ITSU-XV and by writing ITIC. The new version in English and Spanish will be available later this year. Francois Schindele, LDG-Papeete, provided the French translation while Salvador Farreras, ITIC's Associate Director, completed the Spanish translation.

Bibliography of Scientific Journal Articles

(new Section)

The following reference list covers publications on tsunami issues as well as tectonophysics and seismology topics with application to tsunami generation. Although this bibliography covers a broad range of topics it is not intended to be a complete and exhaustive list of what has been published in the field but includes only articles that were received at ITIC or came to the attention of the Newsletter editors.

We encourage the authors of scientific articles in the tsunami community to send a copy of their papers to ITIC to become part of the permanent collection of our Library, and to be listed in this new Section of future issues of the Newsletter as a bibliographic reference for others interested in the field of tsunamis.

Clague J.J. and P.T. Bobrowsky, 1994. Tsunami deposits beneath tidal marshes on Vancouver Island, British Columbia, *Geological Society of America Bulletin,* 106: 1293-1303.

Clague J.J. and P.T. Bobrowsky, 1994. Evidence for a large earthquake and tsunami 100-400 years ago on western Vancouver Island, British Columbia, *Quaternary Research,* 41: 176-184.

Collot J.-Y., Delteil J., Herzer R.H., Wood R., Lewis K.B., and S. Party, 1995. Sonic imaging reveals new plate boundary structures offshore New Zealand, *EOS Transactions of the American Geophysical Union,* 76(1): 1-5.

Djumagaliev V.A. and A.B. Rabinovich, 1993. Long wave investigation at the shelf and in the bays of South Kuril Islands, *Journal of Korean Society of Coastal and Ocean Engineers,* 12(4): 318-328.

Kagan Y.Y. and D.D. Jackson, 1995. New seismic gap hypothesis: five years after, *Journal of Geophysical Research,* 100(B3): 3943-3959.

Kerr R.A., 1995. Faraway tsunami hints at a really big northwest quake, *Science,* 267: 962.

Kostoglodov V. and L. Ponce, 1994. Relationship between subduction and seismicity in the Mexican part of the Middle America trench, *Journal of Geophysical Research,* 99(B1): 729-742.

McCaffrey R. and C. Goldfinger, 1995. Forearc deformation and great subduction earthquakes: implications for Cascadia offshore earthquake potential, *Science,* 267: 856-859.

Satake K., 1994. Mechanism of the 1992 Nicaragua tsunami earthquake, *Geophysical Research Letters,* 21(23): 2519-2522.

Tanioka Y., Satake K., and L. Ruff, 1995. Total analysis of the 1993 Hokkaido Nansei-oki earthquake using seismic wave, tsunami, and geodetic data, *Geophysical Research Letters,* 22(1): 9-12.

Yeh H., Liu P.-L., Briggs M., and C. Synolakis, 1994. Propagation and amplification of tsunamis at coastal boundaries, *Nature,* 372: 353-355.

TSUNAMI WARNING CENTER REPORTS

LDG-CPPT REPORT

ITSU-XV

The Fifteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific (ITSU-XV) will take place, at the invitation of the Government of France, at the Laboratoire de Geophysique (LDG) Papeete, Tahiti, 24-28 July 1995. IOC Circular Letter No. 1445 dated on 8 February 1995, was sent to all ITSU National Contacts inviting their participation at ITSU-XV, requesting submission of National Reports as well as other proposals for future projects in the areas of tsunami warning. Mr. Francois Schindele, Head of the LDG at Tahiti, is the local organizer of the meeting.

CPPT

Trevor Sankey, science adviser of the UNESCO office for

the Pacific States visited CPPT on 10 May 1995 to prepare for the ITSU-XV session. The South Pacific Tsunami warning project was one of the main topics of the discussion.

Because of Papeete harbor modifications, the tide station had to be moved before June 1995. Two NOAA technicians came in May to reinstall the equipment at a new site located a few hundred meters from the old one. A phone line was connected to the station which increases, consequently, the performance of the station by giving a 1 minute data acquisition. During the Loyalty Islands tsunami, a comparison of the new data to the data from the old tide station shows that both sites have similar response in the range of period from a few minutes to 12 hours. The Loyalty Islands event was specially studied because it happened near New Caledonia and generated the last tsunami recorded in Papeete (6 cm). CPPT evaluated correctly in real time the seismic moment and the tsunami risk and forwarded information immediately to PTWC. After the earthquake, a tsunami was recorded at Noumea (11 cm), Pago Pago (10 cm) and at Papeete.

EARTHQUAKE/TSUNAMI SUMMARY

Summary of Pacific Basin Earthquakes with Surface Wave or Moment Magnitudes Greater than or Equal to 6.5 (data provided by PTWC, ATWC, JMA and NEIC, January 1995 through June 1995)

RWW = Regional Watch/Warning
TIB = Tsunami Information Bulletin

Event	Date	Location	Time UTC	Lat.	Long.	Depth Km.	Ms	Mw	Action	Time Issued UTC	
95-01	Jan 6	Nr. E. Coast of Honshu Japan	2238Z	40.2N	142.2E	57	-	7.0	PTWC/TIB	2334Z	
95-02	Jan 16	Kobe Japan	2047Z	34.5N	135.0E	16	6.8	6.8	PTWC/TIB	2126Z	
95-03	Jan 19	Colombia	1505Z	05.1N	72.9W	18	6.6	6.5	PTWC/TIB	1618Z	
95-04	Jan 27	Irian Jaya Region Indonesia	2017Z	04.5S	134.5E	33	6.8	6.7	PTWC/TIB	2123Z	
95-05	Feb 3	Balleny Islands	0232Z	62.7S	155.9E	10	6.3	6.5			
95-06	Feb 5	Off E. Coast of N. Is. N. Z.	2251Z	37.7S	178.8E	59	-	7.1	PTWC/TIB	0014Z	
95-07	Feb 13	Halmahera Indonesia	1504Z	01.4S	127.5E	33	6.8	6.8	PTWC/TIB	1612Z	
95-08	Feb 19	Off Coast of N. California	0403Z	40.6N	125.5W	10	6.8	6.6	ATWC/TIB		
95-09	Mar 19	Irian Jaya Region Indonesia	2353Z	04.1S	135.1E	33	7.1	6.8	PTWC/TIB	0039Z	
95-10	Apr 7	Tonga Islands	2207Z	15.2S	173.6W	31	8.0	7.8	PTWC/RWW	2244Z	
95-11	Apr 17	Kuril Islands	2328Z	45.9N	151.3E	34	6.3	6.8			
95-12	Apr 20	Mindanao Philippine Islands	0845Z	06.3S	126.0E	85	-	6.6			
95-13	Apr 21	Samar Philippine Islands	0010Z	12.0N	125.7E	33	6.9	6.8	PTWC/TIB	0135Z	
95-14	Apr 21	Samar Philippine Islands	0035Z	12.1N	125.9E	23	7.3	7.1			
95-15	Apr 21	Samar Philippine Islands	0517Z	12.1N	125.9E	23	6.9	6.7	PTWC/TIB	0609Z	
95-16	Apr 23	Rat Islands Aleutian Islands	0256Z	51.3N	179.7E	16	6.4	6.5			
95-17	Apr 23	Samar Philippine Islands	0508Z	12.4N	125.4E	33	6.6	6.7			
95-18	Apr 28	Kuril Islands	1630Z	44.1N	148.1E	29	6.9	6.8	PTWC/TIB	1712Z	
95-19	May 2	Northern Peru	0606Z	03.9S	77.0W	103	-	6.7			
95-20	May 5	Samar Philippine Islands	0354Z	12.6N	125.3E	33	7.0	7.1	PTWC/TIB	0450Z	
95-21	May 5	Samar Philippine Islands	0439Z	12.6N	125.2E	55	-	6.5			
95-22	May 14	Timor Indonesia	1133Z	08.4S	125.1E	33	7.0	7.1	PTWC/TIB	1237Z	
95-23	May 16	Loyalty Islands	2013Z	22.9S	169.9E	33	7.7	7.7	PTWC/RWW	2111Z	
95-24	May 17	Loyalty Islands	1124Z	23.1S	170.2E	33	6.6	6.2			
95-25	May 27	Sakhalin Island Russia	1304Z	52.5N	143.0E	33	7.6	7.0	PTWC/TIB	1355Z	
95-26	Jun 14	Off Coast of Central America	1112Z	12.2N	88.4W	33	6.0	6.6			
95-27	Jun 21	Balleny Isands	1529Z	61.8S	154.4E	33	6.7	6.8	PTWC/TIB	1653Z	

MEMBER STATES OF THE

INTERNATIONAL COORDINATION GROUP FOR THE TSUNAMI WARNING SYSTEM IN THE PACIFIC